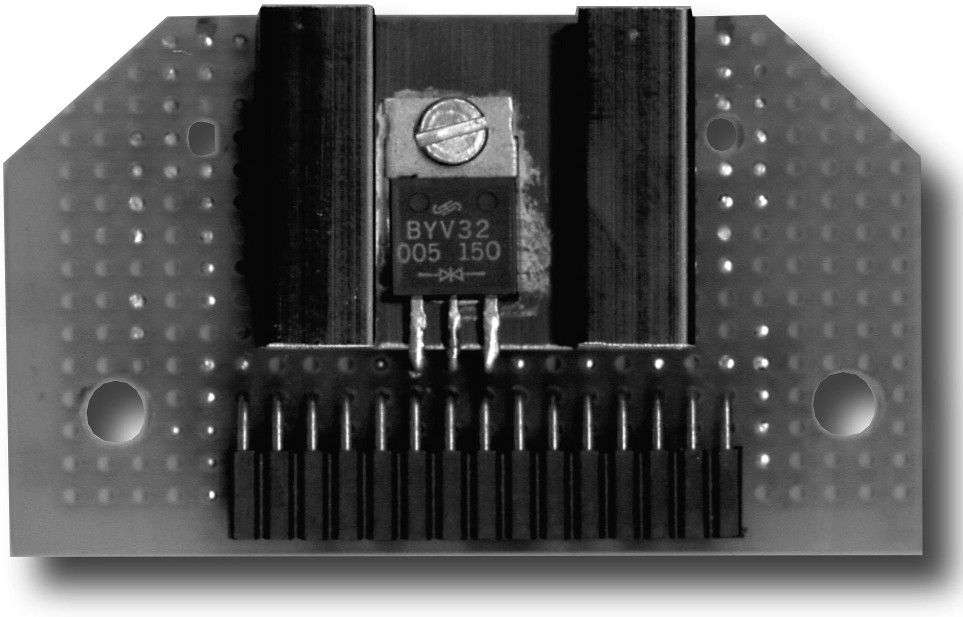
With the introduction of the AMD K6, Cyrix 6x86 and Pentium MMX processors, a second supply voltage is required on the motherboard in addition to the primary voltage of 3.3 to 3.5 V. This additional voltage can be generated using a special voltage regulator, but there is an easier approach. The circuits presented here solve the problem in an especially simple and inexpensive manner.

Design by K. Viernickel

simple CPU voltage regulator

use K6, Cyrix and Pentium MMX processors in older-model computers



Before the time of the Pentium MMX processor, all CPUs used a single supply voltage (3.3 to 3.5 V). However, designers then decided to use a lower supply voltage (2.2 to 2.7 V) for the core of the processor, in order to reduce the amount of heat generated. In the transition period between these two types of CPUs, various motherboard manufacturers provided special expansion connectors on the motherboard to allow an extra voltage regulator to be fitted for CPUs that require two supply voltages. However, these special voltage regulator modules are rather difficult to obtain, especially since modern motherboards have a double supply voltage as a standard feature.

If you want to upgrade a moderately old computer by installing a new CPU, then it’s handy to be able to provide your own solution for the second supply voltage.

It must be said at the outset that the circuit presented here is relatively simple, which naturally means that it has certain limitations. One of these is that the output voltage level may differ slightly from the desired value. It is thus important that you check what the supply voltage tolerance is for the processor used, and use a DVM to measure the actual output voltage of the regulator after switching on the computer, to verify that it is within the allowed range. You should also check the voltage whenever an energy-saving program, such as Waterfall, is active. The reduced current consumption in the energy-saving mode can cause the output voltage to increase slightly. You need not be unduly concerned about small variations in the voltage level, but it is important to be sure that everything is proper.

Two options, two circuits

Figure 1 shows the approach used to reduce a 3.5 V supply voltage to 2.8 V. This approach is needed when a Pentium processor with MMX technology is used, among others. The dual diode used here (Philips BYV32/100) has a forward voltage drop that is slightly more than 0.7 V across the PN junction, as can be seen from the characteristic curve in **Figure 2**. If the CPU supply voltage on the motherboard is set to 3.5 V,

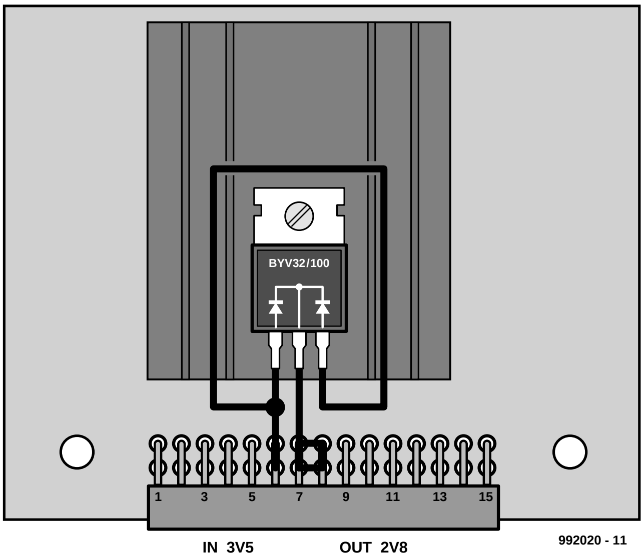


Figure 1. This circuit can be used to generate the additional supply voltage for a Pentium MMX processor.

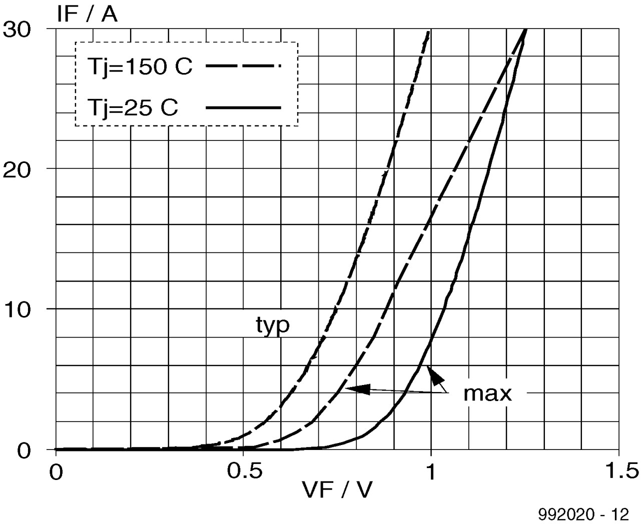


Figure 2. Conduction characteristics of the BYV32 diode. The forward voltage is shown on the horizontal axis and the forward current on the vertical axis.

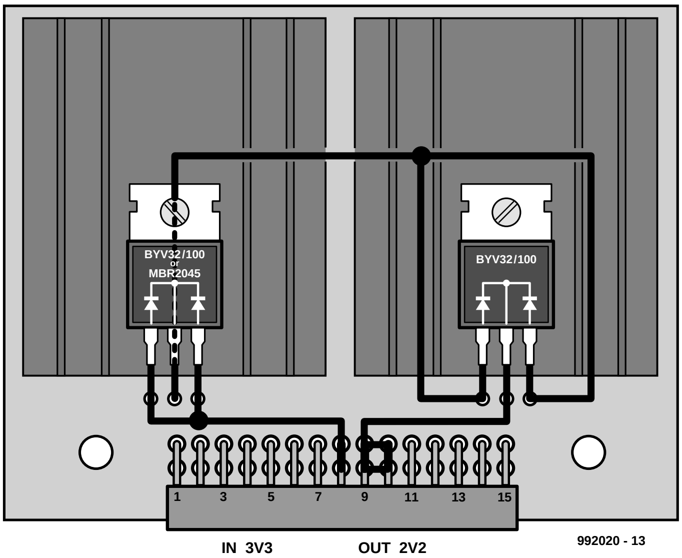


Figure 3. This circuit can be used if you decide to use an AMD K6-2.

then the output voltage will indeed be reduced to the desired level of 2.8 V. The diodes can together handle up to 20 A, which is more than enough for the job at hand.
A pair of diodes can be used in a similar manner to reduce the supply voltage from 3.3 V to 2.2 V, as shown in Figure 3. This approach can be used with an AMD K6-2 processor. In this case the basic idea is that the 3.3 V voltage is dropped to roughly 2.2 V by means of two diode voltage drops in series. Here we use either two BYV32 devices or one BYV32 plus one MBR1035/1045. The latter is a Schottky diode whose maximum forward voltage drop is 0.57 V at 10 A. The voltage drop is even less at lower current levels. The series connection of a BYV32 pair and am MBR1045 provides a voltage drop of 1.1 to 1.2 V, which is exactly what is needed in this case.
Connecting the two PN junctions of the BYV32 in parallel causes the relatively high current to be split between the two diodes, which results in a smaller voltage drop per diode.
The two circuits work with two different input voltages (3.3 and 3.5 V). The voltage level can usually be selected by means of a jumper on the motherboard. In practice, it does not matter all that much to the processor whether it works with 3.3 V or 3.5 V, but the level of the second supply voltage is clearly more critical.

Construction

It's easy to build the circuit and connect it to the motherboard. Mount the diode(s) together with a heat sink on a piece of prototyping board, and add a two-row, 30-pin right-angle connector. The wiring diagrams of **Figures 1 and 3** indicate the necessary connections. The photo in **Figure 4** shows the prototype build by the author. Once you have fitted the regulator board to the motherboard connector and set the jumpers correctly, your PC is ready for a second (and faster) life.

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Table 1. Processor operating voltages.

type	Core voltage	I/O voltage
Pentium (P54C)	3.3 - 3.5 V	3.3 - 3.5 V
Pentium MMX (P55C)	2.8 V	3.3 - 3.5 V
AMD K5 PR75 - PR300	3.3 - 3.5 V	3.3 - 3.5 V
AMD K6 PR166 - PR200	2.9 V	3.3 V
AMD K6 PR233	3.2 V	3.3 V
AMD K6 PR266 - PR300	2.2 V	3.3 V
AMD K6-2 PR266 - PR400	2.2 V	3.3 V
Cyrix 6x86 P120+ - P200+	3.3 - 3.5 V	3.3 - 3.5 V
Cyrix 6x86MX PR166 - PR266	2.9 V	3.3 V